PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-265089
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(71)Applicant : MURATA MFG CO LTD
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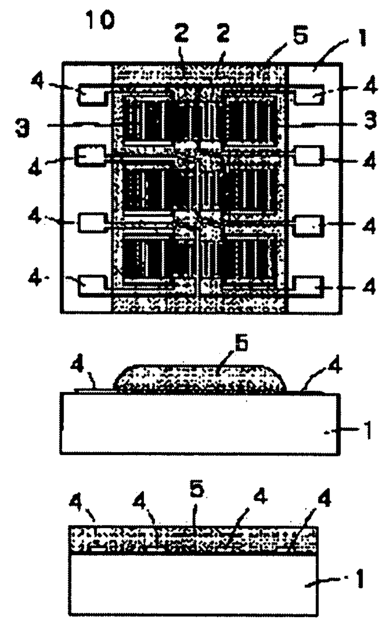
HIRAISHI AKIRA

(54) SURFACE ACOUSTIC WAVE ELEMENT AND ITS MANUFACTURE

(57)Abstract:
PURPOSE: To realize the surface acoustic wave element with an excellent characteristic without increasing the size of the surface acoustic wave element.
CONSTITUTION: Three stages of surface acoustic wave filters each comprising a couple of reflector electrodes 3, 3 and two IDT electrodes 2, 2 formed between the reflector electrodes 3, 3 on a substrate 1 are arranged in parallel. Then plural external extract electrodes 4 are formed to the outside of the forming area of the plural reflector electrodes 3 and an SiO2 thin film 5 is formed between opposed end faces of the substrate 1 to the middle part of the substrate 1 except the area where the plural external extract electrodes 4 are formed so that the plural IDT electrodes 2 and the plural reflector electrodes 3 are covered between the opposed end faces of the substrate 1.



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[Date of request for examination] 07.03.2002
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PURPOSE: To realize the surface acoustic wave element with an excellent characteristic without increasing the size of the surface acoustic wave element.

CONSTITUTION: Three stages of surface acoustic wave filters each comprising a couple of reflector electrodes 3, 3 and two IDT electrodes 2, 2 formed between the reflector electrodes 3, 3 on a substrate 1 are arranged in parallel. Then plural external extract electrodes 4 are formed to the outside of the forming area of the plural reflector electrodes 3 and an SiO2 thin film 5 is formed between opposed end faces of the substrate 1 to the middle part of the substrate 1 except the area where the plural external extract electrodes 4 are formed so that the plural IDT electrodes 2 and the plural reflector electrodes 3 are covered between the opposed end faces of the substrate 1.

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CLAIMS

[Claim(s)]

[Claim 1] It is the surface acoustic wave device characterized by being formed by uniform thickness for the end face when either of the directions where said thin film is perpendicular to the surface wave propagation direction of said substrate or the surface wave propagation direction counters in the surface acoustic wave device by which the thin film was alternatively formed on said substrate so that the electrode which constitutes a surface acoustic wave device might be formed on a substrate and the predetermined part of said electrode might be covered.

[Claim 2] Arrange the mask with which the aperture was prepared on the mother substrate with which the surface acoustic wave device which has a predetermined electrode was arranged and formed in two or more regulation target, and it lets the aperture of said mask pass. In the manufacture approach of the surface acoustic wave device which cuts said mother substrate with a cutting machine, and starts each surface acoustic wave device after forming a thin film alternatively on said mother substrate so that the predetermined part of said electrode may be covered In the direction of either of the directions perpendicular to the surface wave propagation direction of said mother substrate, or the surface wave propagation direction By forming said thin film using the mask which has the aperture continuously formed ranging over said two or more surface acoustic wave devices The manufacture approach of the surface acoustic wave device characterized by forming the thin film over between the end faces which either of the directions perpendicular to the surface wave propagation direction of the substrate of the surface acoustic wave device after cutting or the surface wave propagation direction counters.

[Translation done.]

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the surface acoustic wave device by which the thin film was alternatively formed on the substrate, and its manufacture approach.
[0002]
[Description of the Prior Art] For example, because of the purposes, such as a temperature characteristic improvement, it is SiO2 to parts other than the external drawing electrode of a surface acoustic wave device. When forming a thin film alternatively, as shown in drawing 7 On the mother substrate 11 with which many surface acoustic wave devices 10 were formed, correspond conventionally each [as shown in drawing 8] surface acoustic wave device 10 of every. The metal (for example, product made from stainless steel) mask 20 with which many apertures 21 of a square smaller than the size of a surface acoustic wave device 10 were formed is carried. From a mask 20 to SiO2 It is SiO2 alternatively into the predetermined part of each surface acoustic wave device 10 by carrying out sputtering. The thin film 5 is formed.
[0003] And SiO2 A dicer etc. cuts the above-mentioned mother substrate 11 after thin film formation, and each surface acoustic wave device 10 as shown in drawing 9 is formed. drawing -- setting -- the point painting-out section -- SiO2 A thin film is shown. The bay of the periphery of a mask 20 is for carrying out alignment to the so-called orientation flat which shows the surface wave propagation direction of the mother substrate 11 in piles.

[0004] The conventional surface acoustic wave device 10 shown in drawing 9 is SiO2 by the mask as been the surface wave resonator filter of a vertical joint mold and shown in drawing 8 . A thin film is formed. A top view, this drawing (b), and (c) of drawing 9 (a) are the abbreviation sectional views of a direction perpendicular to the surface wave propagation direction and the surface wave propagation direction.

[0005] This surface acoustic wave device 10 is LiTaO3. Two IDT electrodes 2 and 2 are approached and formed on a substrate 1, the reflector electrodes 3 and 3 of a pair are formed in the outside of IDT 2 and 2, and the external drawing electrode 4 is pulled out and formed from the connection of the electrode finger of each IDT electrode 2. And it is SiO2 so that the IDT electrodes 2 and 2 and the reflector electrodes 3 and 3 may be covered in the center section of the substrate 1 except the periphery section in which the external drawing electrodes 4 and 4 were formed. The thin film 5 is formed. The bonding wire for taking electrical installation with the exterior etc. is connected to the external drawing electrodes 4 and 4.

[0006] In addition, the surface wave propagation direction is the array direction of the IDT electrodes 2 and 2 and the reflector electrodes 3 and 3.

[0007]

[Problem(s) to be Solved by the Invention] Usually, it is thinly formed so that it may incline, as the thin film near the periphery section of an aperture is shown in drawing 9 (b) and (c), since a gap is between a mask and a substrate to some extent while the particle of a thin film material becomes the shadow of a mask in the periphery section inside of the aperture of a mask, when forming a thin film by a spatter etc. through the aperture of a mask, and it turns also to the outside of the aperture of a mask, and it becomes uneven thickness. That is, although the thin film formed in the part corresponding to the aperture of a mask is formed by uniform thickness in the center section, it is formed in the condition of having gradually decreased toward the direction of outside near the periphery section of an aperture.

[0008] However, in the surface acoustic wave device shown in conventional drawing 9 , since the edge of the thin film used as the above-mentioned uneven thickness was formed in any direction perpendicular to the surface wave propagation direction and the surface wave propagation direction of a direction in the substrate 1, there was a problem that a desired property was not acquired.
[0009] In the configuration shown in drawing 9 , it specifically sets near the reflector electrode 3 of the surface wave propagation direction, and is SiO2. When the thickness of a thin film 5 was changing, there were problems, like turbulence and an unnecessary ripple arise [the phase of the surface wave reflected with the reflector electrode 3] especially in a band. Moreover, it sets in the direction perpendicular to the surface wave propagation direction although not illustrated, when two or more steps of configurations of the IDT electrode shown in drawing 9 and a reflector electrode are arranged in the direction perpendicular to the surface wave propagation direction, cascade connection of each stage is carried out and a filter is formed, and is SiO2. When the thickness of a thin film 5 changed, since the acoustic velocity in each stage, i.e., the frequency of each stage, differed, there was a problem that a desired filter shape was not obtained.
[0010] An IDT electrode and a reflector electrode, and SiO2 It is SiO2 so that distance with the edge of a thin film may become large. In this case, although the above-mentioned problem is also solvable by forming the formation field of a thin film greatly, since the size of a surface acoustic wave device becomes large, a miniaturization becomes difficult, a component can be taken, the number decreases, and the yield and productivity worsen.
[0011] Then, the purpose of this invention is to offer the surface acoustic wave device of a good property, without enlarging size of a surface acoustic wave device by canceling the trouble which the above conventional surface acoustic wave devices have, and forming the thin film of uniform thickness for the end face when the surface acoustic wave device of a direction perpendicular to the surface wave propagation direction or the surface wave propagation direction

counters.

[0012]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention concerning claim 1 In the surface acoustic wave device by which the electrode which constitutes a surface acoustic wave device was formed on the substrate, and the thin film was alternatively formed on said substrate so that the predetermined part of said electrode might be covered said thin film It is characterized by being formed using a mask and formed by uniform thickness for the end face when either of the directions perpendicular to the surface wave propagation direction of said substrate or the surface wave propagation direction counters.

[0013] Invention concerning claim 2 arranges the mask with which the aperture was prepared on the mother substrate with which the surface acoustic wave device which has a predetermined electrode was arranged and formed in two or more regulation target, and lets the aperture of said mask pass. In the manufacture approach of the surface acoustic wave device which cuts said mother substrate with a cutting machine, and starts each surface acoustic wave device after forming a thin film alternatively on said mother substrate so that the predetermined part of said electrode may be covered In the direction of either of the directions perpendicular to the surface wave propagation direction of said mother substrate, or the surface wave propagation direction By forming said thin film using the mask which has the aperture continuously formed ranging over said two or more surface acoustic wave devices It is characterized by forming the thin film over between the end faces which either of the directions perpendicular to the surface wave propagation direction of the substrate of the surface acoustic wave device after cutting or the surface wave propagation direction counters.

[0014]

[Function] According to invention concerning claim 1, in perpendicular to the surface wave propagation direction of a substrate, or the surface wave propagation direction one direction of either of the directions, since the thin film is

formed by uniform thickness for the end face, property degradation by change of the thickness in this direction does not take place. In addition, it is determined by the configuration of a surface acoustic wave device, and demand characteristics whether it is made which direction, and the direction which has big effect on a property is selected.

[0015] According to invention concerning claim 2, in one direction of either of the directions perpendicular to the surface wave propagation direction of the substrate of each surface acoustic wave device, or the surface wave propagation direction, the thin film of uniform thickness without change of thickness can be formed for the end face which counters.

[0016]

[Example] Hereafter, this invention is explained based on the drawing in which the example is shown. In drawing, the same sign is attached about the same as that of the conventional example or a corresponding part, and the thing of the same function.

[0017] Drawing 1 is drawing showing the configuration of the surface acoustic wave device concerning the 1st example of this invention, and (a) is [the abbreviation sectional view of the surface wave propagation direction and (c of a top view and (b))] the abbreviation sectional views of a direction perpendicular to the surface wave propagation direction. Drawing 2 is the top view of the mask used in this example.

[0018] As shown in drawing 1 , the surface acoustic wave device 10 of this example is LiTaO3 of 36 degreeY cut X propagation. It is the vertical joint mold resonator filter of the three-step configuration which carried out the three-piece parallel arrangement of the vertical joint mold resonator filter with which the reflector electrodes 3 and 3 were formed in the both sides of two IDT electrodes 2 and 2 and IDT electrodes 2 and 2 in the direction perpendicular to the surface wave propagation direction, and carried out cascade connection of each stage on the substrate 1. It is the end-face side which a substrate 1 counters, and two or more external drawing electrodes 4 pulled out from each IDT electrode 2 are

formed outside the formation location of the reflector electrode 3.

[0019] It is SiO2 so that each IDT electrode 2 and each reflector electrode 3 may be covered for a both-ends side in the center section in which the IDT electrode 2 and the reflector electrode 3 except the both-ends side side in which the external drawing electrode 4 was formed were formed. The thin film 5 is formed. SiO2 In the surface wave propagation direction, as shown in drawing 1 (b), in the substrate 1, a thin film 5 has the uneven edge of thickness, is formed by uneven thickness, but in the direction perpendicular to the surface wave propagation direction, as shown in drawing 1 (c), it is formed by uniform thickness for the both-ends side.

[0020] SiO2 A thin film 5 to the position on the mother substrate (not shown) with which many surface acoustic wave devices 10 shown in drawing 1 were formed Arrange the metal mask 20 with which many long and slender apertures 21 which while it seems that it is shown in drawing 2 follows ranging over many surface acoustic wave devices only in a direction were arranged in parallel, and were formed, and it lets the aperture 21 of a mask 20 pass. SiO2 By carrying out sputtering, it is SiO2 to the part corresponding to an aperture 21. It is made to adhere and is formed.

[0021] And SiO2 A dicer etc. cuts the above-mentioned mother substrate after thin film 5 formation, and each surface acoustic wave device 10 shown in drawing 1 is formed. That is, it sets in one direction and is SiO2 with uniform thickness. It continues between the end faces which a substrate 1 counters since a thin film 5 is continued and formed in many surface acoustic wave devices 10 and is perpendicularly cut to the substrate 1 by the boundary line of each surface acoustic wave device 10, and is SiO2 of uniform thickness. A thin film 5 is formed.

[0022] Below, the thickness distribution and the filter shape in the surface acoustic wave device of a configuration of being shown in drawing 1 are explained as contrasted with the conventional thing.

[0023] It is SiO2 by the RF magnetron sputtering method. The result of having measured the thickness distribution in a direction perpendicular to the surface

wave propagation direction when forming about 8.6 micrometers of thin films is shown in drawing 3 . It sets to drawing 3 and is SiO2 of this example. A continuous line shows thickness distribution of a thin film, and a broken line shows the conventional thing. SiO2 shown with a broken line The part from which a thin film is set to about 0 micrometer is a location corresponding to the batch section of the aperture in the mask shown in conventional drawing 8 , and spacing of this part is equivalent to the width of face of a direction perpendicular to the surface wave propagation direction of a surface acoustic wave device, and it is 3500 micrometers in dimension in the example. In addition, A, B, and C show the width of face of the part equivalent to - [the 1st step of] the 3rd step of each resonator filter.

[0024] SiO2 formed with the conventional mask as shown in drawing 3 The thickness of a thin film serves as uneven distribution. The flat part of thickness distribution is about 1500 micrometers in width of face of a center section, and compared with the 1st step and the 3rd step of resonator sections A and C, about 0.3 micrometers of thickness in the 2nd step of resonator section B are thickly formed on an average, and it serves as remarkable uneven thickness distribution within the 1st step and the 3rd step of resonator sections A and C. On the other hand, SiO2 concerning this example A thin film covers the overall length of width of face, and serves as uniform thickness distribution.

[0025] Moreover, in the conventional surface acoustic wave device, if there is a gap of the alignment of a mask, each interstage and the thickness in each stage will change still a lot, but in the surface acoustic wave device of this example, even if there is a location gap of a mask, uniform thickness distribution can be acquired.

[0026] drawing 4 -- the total electrode finger of an IDT electrode -- it is drawing showing the filter shape at the time of forming a logarithm by 16 pairs and the 2nd step of resonator by the 1st step and the 3rd step of resonator, and forming each the electrode finger of 18 pairs and the reflector electrode of each stage by 50. In drawing 4 , a continuous line shows the thing of this example and a broken

line shows the conventional thing.

[0027] As shown in drawing 4 , in the conventional surface acoustic wave device shown with a broken line, the ripple arose in the low-pass side in a passband, pass band width became narrow, and the unnecessary ripple arose also outside the passband, and the big ripple has occurred also in group delay frequency characteristics. This is SiO2 at the 1st step and the 3rd step of resonator, and the 2nd step of resonator. Since the thickness of a thin film differs, while a sonic difference arises and the center frequency of a resonator differs, it is because distribution is possible for acoustic velocity in the resonator of each stage.

[0028] On the other hand, the overall length of the orientation of each stage is covered in the surface acoustic wave device of this example shown as a continuous line, and it is SiO2. Since the thin film was formed by uniform thickness, the good filter shape which does not have a ripple etc. into a passband was obtained.

[0029] Moreover, in the conventional surface acoustic wave device, in order to reduce the above faults, it is necessary to extend the uniform part of thickness, and size of a component must be enlarged, but since according to the configuration of this example a thin film is formed by uniform thickness for an end face and the membranous edge is formed in the right angle, it is not necessary to enlarge size of a component and it becomes possible to miniaturize more.

[0030] Drawing 5 is drawing showing the configuration of the surface acoustic wave device concerning the 2nd example of this invention, and (a) is [the abbreviation sectional view of the surface wave propagation direction and (c of a top view and (b))] the abbreviation sectional views of a direction perpendicular to the surface wave propagation direction. Drawing 6 is the top view of the mask used in this example.

[0031] As shown in drawing 5 , the surface acoustic wave device 10 of this example is LiTaO3 of 36 degreeY cut X propagation. It is the vertical joint mold resonator filter of an one-step configuration with which the reflector electrodes 3 and 3 were formed on the substrate 1 at the both sides of two IDT electrodes 2

and 2 and IDT electrodes 2 and 2. It is the end-face side which a substrate 1 counters, and two or more external drawing electrodes 4 pulled out from each IDT electrode 2 are formed outside the formation location of the IDT electrode 2 and the reflector electrode 3.

[0032] It is SiO2 so that the IDT electrode 2 and the reflector electrode 3 may be covered for a both-ends side in the center section in which the IDT electrode 2 and the reflector electrode 3 except the both-ends side side in which the external drawing electrode 4 was formed were formed. The thin film 5 is formed.

[0033] This surface acoustic wave device 10 on the mother substrate (not shown) with which many surface acoustic wave devices 10 shown in drawing 5 were formed Arrange the metal mask 20 formed so that the long and slender aperture 21 which while it seems that it is shown in drawing 6 R> 6 follows ranging over many surface acoustic wave devices only in a direction might arrange a large number in parallel, and it lets the aperture 21 of a mask 20 pass. SiO2 By carrying out sputtering, it is SiO2 to the part corresponding to an aperture 21. It is made to adhere and is SiO2. A thin film 5 is formed, and after that, a dicer etc. cuts a mother substrate and it is formed.

[0034] That is, SiO2 of this example In the surface wave propagation direction, as shown in drawing 5 (b), a thin film 5 is formed by uniform thickness for a both-ends side, in the direction perpendicular to the surface wave propagation direction, as shown in drawing 5 (c), has the uneven edge of thickness and is formed by uneven thickness in the substrate 1.

[0035] SiO [according to this configuration]2 in the surface wave propagation direction Since the thin film is formed by uniform thickness for the end face and there is no change of thickness, the phase of a reflected wave is not confused. That is, degradation of the electrical characteristics by the phase turbulence of the reflected wave resulting from thickness change of a thin film does not take place, but good electrical characteristics can be acquired.

[0036] Furthermore, since a thin film is formed by uniform thickness for the end face of a substrate and the membranous edge is formed in the right angle, a

reflector can be arranged near the end face of a substrate and the size of a component can be miniaturized.

[0037] In addition, it is SiO2 so that the reflector electrode and IDT electrode which were formed on the piezo-electric substrate in each above-mentioned example may be covered. Although the vertical joint mold resonator filter in which the thin film was formed explained The configuration of the electrode which constitutes the class of substrate, the class of thin film, and a surface acoustic wave device etc. is not restricted to this, and the substrate and the thin film could consist of one IDT electrode as an electrode which the insulating thin film of piezoelectric or others is sufficient as, and constitutes a surface acoustic wave device.

[0038] For example, this invention can be applied, when forming an IDT electrode etc. on insulating substrates, such as glass, and forming piezoelectric thin films, such as ZnO, alternatively on this electrode, or also when forming an IDT electrode etc. on the substrate in which the ZnO thin film was formed all over silicon on sapphire and forming an insulating or piezoelectric thin film alternatively on this electrode for a property improvement or electrode protection.

[0039]

[Effect of the Invention] Since it is formed by uniform thickness for the end face when a thin film counters in an important direction on a property on a substrate according to this invention as explained above, there is no property degradation resulting from change of the thickness in this direction, and a good property can be acquired.

[0040] Moreover, since the dimension of a surface acoustic wave device can be formed small, while miniaturizing a surface acoustic wave device, it can be in one mother substrate, the number can be made [many], and cost can be reduced.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The abbreviation sectional view of the surface wave propagation direction and (c of the top view of the surface acoustic wave device which (a) requires for the 1st example of this invention, and (b)) are the abbreviation sectional views of a direction perpendicular to the surface wave propagation direction.

[Drawing 2] It is the top view of the mask concerning the 1st example of this invention.

[Drawing 3] SiO2 of this invention and the conventional surface acoustic wave device It is drawing showing thickness distribution of a thin film.

[Drawing 4] It is the filter shape of this invention and the conventional surface acoustic wave device.

[Drawing 5] The abbreviation sectional view of the surface wave propagation direction and (c of the top view of the surface acoustic wave device which (a) requires for the 2nd example of this invention, and (b)) are the abbreviation sectional views of a direction perpendicular to the surface wave propagation direction.

[Drawing 6] It is the top view of the mask concerning the 2nd example of this invention.

[Drawing 7] It is the top view of a mother substrate in which many conventional surface acoustic wave devices were formed.

[Drawing 8] It is the top view of the conventional mask.
[Drawing 9] (a) is [the abbreviation sectional view of the surface wave propagation direction and (c of the top view of the conventional surface acoustic wave device and (b))] the abbreviation sectional views of a direction perpendicular to the surface wave propagation direction.

[Description of Notations]

1 Substrate

2 IDT Electrode

3 Reflector Electrode

4 External Drawing Electrode

5 SiO2 Thin Film

10 Surface Acoustic Wave Device

11 Mother Substrate

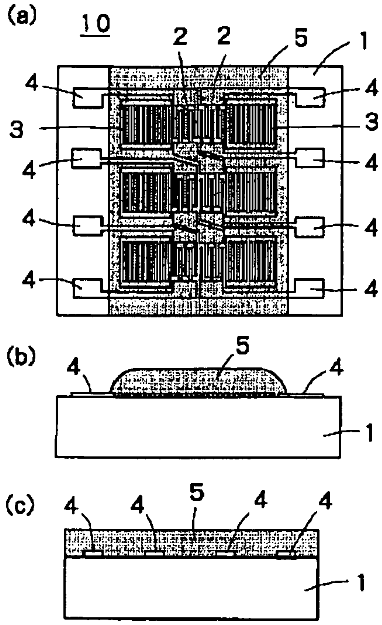
20 Mask

21 Aperture

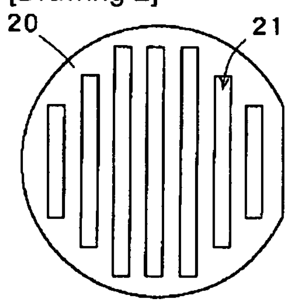
[Translation done.]

DRAWINGS

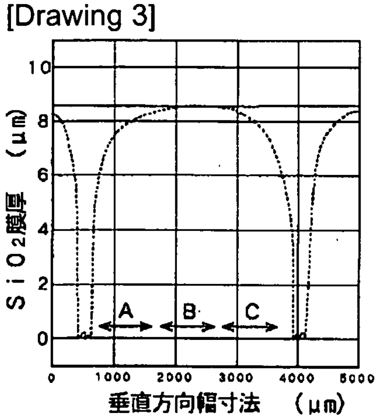
[Drawing 1]



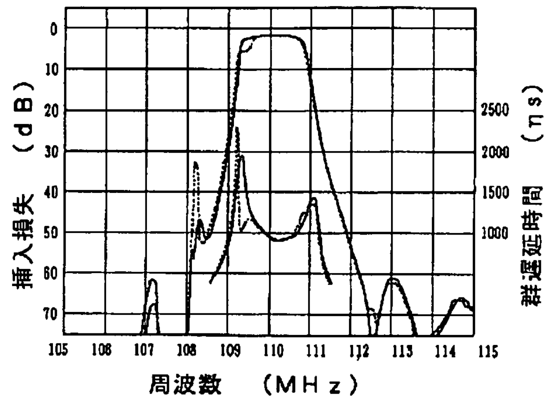
[Drawing 2]



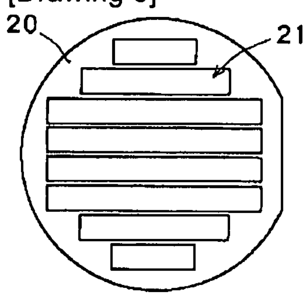
[Drawing 3]



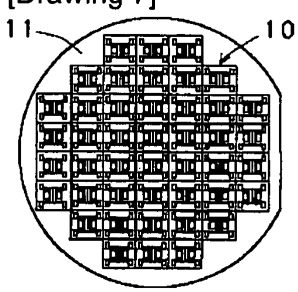
[Drawing 4]



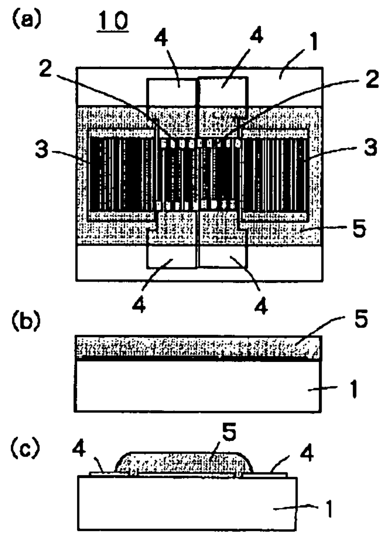
[Drawing 6]



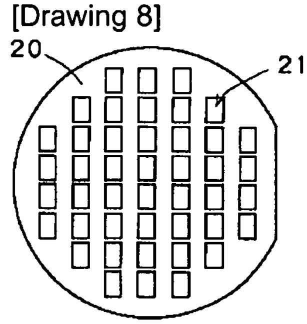
[Drawing 7]



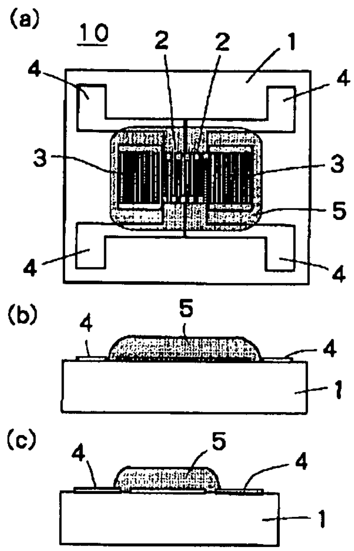
[Drawing 5]



[Drawing 8]



[Drawing 9]



[Translation done.]

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(43)公開日　平成8年(1996)10月11日

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H03H	9/145		7259－5J	H03H	9/145	C	
	3/08		7259－5J		3/08		

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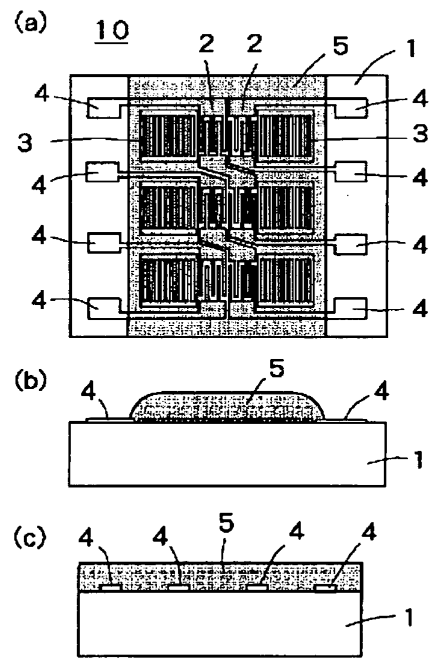
(54)【発明の名称】表面波素子及びその製造方法

(57)【要約】
【目的】表面波素子のサイズを大きくすることなく、良好な特性の表面波素子を提供する。
【構成】基板1上に、一対の反射器電極3、3と反射器電極3、3の間に形成された2個のIDT電極2、2とからなる表面波共振子フィルタが3段並列配置され、複数の反射器電極3形成領域のそれぞれの外側には複数の外部取出し電極4が形成され、複数の外部取出し電極4が形成された領域を除く基板1の中央部には、複数のIDT電極2及び複数の反射器電極3を覆うように、基板1の対向する端面間に亘って、SiO2 薄膜5が形成されている。



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【特許請求の範囲】

【請求項１】　基板上に、表面波素子を構成する電極が形成され、前記電極の所定の部分を覆うように、前記基板上に選択的に薄膜が形成された表面波素子において、前記薄膜は、前記基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれか一方の対向する端面間に亘って、均一な膜厚で形成されていることを特徴とする表面波素子。

【請求項２】　所定の電極を有する表面波素子が複数規則的に配列されて形成された母基板上に、窓が設けられたマスクを配置し、前記マスクの窓を通して、前記電極の所定の部分を覆うように前記母基板上に選択的に薄膜を形成した後、前記母基板を切断機により切断し、個々の表面波素子を切り出す表面波素子の製造方法において、

前記母基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれか一方の方向において、複数の前記表面波素子に跨がって連続して形成された窓を有するマスクを用いて、前記薄膜を形成することにより、切断後の表面波素子の基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれか一方の対向する端面間に亘る薄膜を形成することを特徴とする表面波素子の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、基板上に選択的に薄膜が形成された表面波素子及びその製造方法に関する。

【０００２】

【従来の技術】例えば温度特性改善等の目的のために、表面波素子の外部取出し電極以外の部分にSiO_2薄膜を選択的に形成する場合、図７に示すように、多数の表面波素子１０が形成された母基板１１上に、従来、図８に示すような各表面波素子１０毎に対応する、表面波素子１０のサイズよりも小さめの四角形の窓２１が多数形成された金属製（例えばステンレス製）のマスク２０を載せて、マスク２０の上からSiO_2をスパッタリングすることにより各表面波素子１０の所定の部分に選択的にSiO_2薄膜５を形成している。

【０００３】そして、SiO_2薄膜形成後、上記母基板１１をダイサー等により切断して、図９に示すような個々の表面波素子１０が形成される。図において、点塗り潰し部はSiO_2薄膜を示す。マスク２０の外周の直線部は、母基板１１の表面波伝搬方向を示すいわゆるオリエンテーションフラットと重ねて位置合わせするためのものである。

【０００４】図９に示す従来の表面波素子１０は、縦結合型の表面波共振子フィルタであり、図８に示すようなマスクによりSiO_2薄膜を形成したものである。図９（ａ）は平面図、同図（ｂ）及び（ｃ）は、表面波伝搬方向及び表面波伝搬方向と垂直な方向の略断面図である。

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【０００５】この表面波素子１０は、例えば$LiTaO_3$の基板１上に、２つのＩＤＴ電極２、２が近接して形成され、ＩＤＴ２、２の外側には一対の反射器電極３、３が形成され、それぞれのＩＤＴ電極２の電極指の接続部からは外部取出し電極４が引出されて形成されている。そして、外部取出し電極４、４が形成された周縁部を除く基板１の中央部には、ＩＤＴ電極２、２及び反射器電極３、３を覆うようにSiO_2薄膜５が形成されている。外部取出し電極４、４には外部との電気的接続をとるためのボンディングワイヤ等が接続される。

【０００６】なお、表面波伝搬方向とは、ＩＤＴ電極２、２及び反射器電極３、３の配列方向である。

【０００７】

【発明が解決しようとする課題】通常、マスクの窓を通してスパッタ等により薄膜を形成する場合、薄膜材料の粒子は、マスクの窓の周縁部内側ではマスクの影になるとともに、マスクと基板との間にはある程度ギャップがありマスクの窓の外側にも回り込むので、窓の周縁部近傍の薄膜は、図９（ｂ）及び（ｃ）に示すように、傾斜するように薄く形成され、不均一な膜厚となる。つまり、マスクの窓に対応する部分に形成される薄膜は、中央部では均一な膜厚で形成されるが、窓の周縁部近傍では外方向に向って漸減した状態に形成される。

【０００８】しかしながら、従来の図９に示す表面波素子では、表面波伝搬方向及び表面波伝搬方向と垂直な方向のいずれの方向にも、上記の不均一な膜厚となる薄膜の縁端部が基板１内に形成されているので、所望の特性が得られないという問題があった。

【０００９】具体的には、図９に示す構成においては、表面波伝搬方向の反射器電極３の近傍においてSiO_2薄膜５の膜厚が変化していることにより、反射器電極３で反射される表面波の位相が乱れ、特に帯域内に不要なリップルが生じる等の問題があった。また、図示しないが、図９に示すＩＤＴ電極及び反射器電極の構成を表面波伝搬方向と垂直な方向に複数段配置し、各段を縦続接続してフィルタを形成した場合は、表面波伝搬方向と垂直な方向においてSiO_2薄膜５の膜厚が変化することにより、各段での音速、つまり各段の周波数が異なるために所望のフィルタ特性が得られないという問題があった。

【００１０】ＩＤＴ電極及び反射器電極とSiO_2薄膜の縁端部との距離が大きくなるようにSiO_2薄膜の形成領域を大きく形成することで、上記問題を解決することもできるが、この場合は、表面波素子のサイズが大きくなるので、小形化が困難となり、素子の取れ個数が少なくなり、歩留りや生産性が悪くなる。

【００１１】そこで、本発明の目的は、以上のような従来の表面波素子が持つ問題点を解消し、表面波伝搬方向または表面波伝搬方向と垂直な方向の表面波素子の対向

する端面間に亘って、均一な膜厚の薄膜を形成することにより、表面波素子のサイズを大きくすることなく、良好な特性の表面波素子を提供することにある。

【００１２】

【課題を解決するための手段】上記目的を達成するために、請求項１に係る発明は、基板上に、表面波素子を構成する電極が形成され、前記電極の所定の部分を覆うように、前記基板上に選択的に薄膜が形成された表面波素子において、前記薄膜は、マスクを用いて形成され、前記基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれか一方の対向する端面間に亘って、均一な膜厚で形成されていることを特徴とするものである。

【００１３】請求項２に係る発明は、所定の電極を有する表面波素子が複数規則的に配列されて形成された母基板上に、窓が設けられたマスクを配置し、前記マスクの窓を通して、前記電極の所定の部分を覆うように前記母基板上に選択的に薄膜を形成した後、前記母基板を切断機により切断し、個々の表面波素子を切り出す表面波素子の製造方法において、前記母基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれか一方の方向において、複数の前記表面波素子に跨がって連続して形成された窓を有するマスクを用いて、前記薄膜を形成することにより、切断後の表面波素子の基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれか一方の対向する端面間に亘る薄膜を形成することを特徴とするものである。

【００１４】

【作用】請求項１に係る発明によれば、基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれかの一方の方向では、薄膜は端面間に亘って均一な膜厚で形成されているので、この方向における膜厚の変化による特性劣化が起こらない。なお、いずれの方向にするかは、表面波素子の構成、要求特性により決定され、特性に大きな影響を及ぼす方向が選定される。

【００１５】請求項２に係る発明によれば、個々の表面波素子の基板の表面波伝搬方向または表面波伝搬方向と垂直な方向のいずれかの一方の方向においては、対向する端面間に亘って、膜厚の変化のない均一な厚みの薄膜を形成することができる。

【００１６】

【実施例】以下、本発明をその実施例を示す図面に基づいて説明する。図において、従来例と同一または相当する部分、同一機能のものについては同一符号を付す。

【００１７】図１は、本発明の第１実施例に係る表面波素子の構成を示す図であり、（ａ）は平面図、（ｂ）は表面波伝搬方向の略断面図、（ｃ）は表面波伝搬方向と垂直な方向の略断面図である。図２は本実施例において用いたマスクの平面図である。

【００１８】図１に示すように、本実施例の表面波素子１０は、３６°ＹカットＸ伝搬の$LiTaO_3$基板１上に、２個のＩＤＴ電極２、２及びＩＤＴ電極２、２の両側に反射器電極３、３が形成された縦結合型共振子フィルタを表面波伝搬方向と垂直な方向に３個並列配置し、各段を縦続接続した３段構成の縦結合型共振子フィルタである。基板１の対向する端面側であって、反射器電極３の形成位置よりも外側には、それぞれのＩＤＴ電極２から引出された複数の外部取出し電極４が形成されている。

【００１９】外部取出し電極４が形成された両端面側を除く、ＩＤＴ電極２及び反射器電極３が形成された中央部には両端面間に亘って、各ＩＤＴ電極２及び各反射器電極３を覆うようにSiO_2薄膜５が形成されている。SiO_2薄膜５は、表面波伝搬方向においては、図１（ｂ）に示すように、基板１内に膜厚の不均一な縁端部があり、不均一な厚みで形成されているが、表面波伝搬方向と垂直な方向においては、図１（ｃ）に示すように、両端面間に亘って均一な厚みで形成されている。

【００２０】SiO_2薄膜５は、図１に示す表面波素子１０が多数形成された母基板（図示せず）上の所定の位置に、図２に示すような一方の方向においてのみ多数の表面波素子に跨がって連続する細長い窓２１が多数並列されて形成された金属製のマスク２０を配置し、マスク２０の窓２１を通して、SiO_2をスパッタリングすることにより、窓２１に対応する部分にSiO_2を付着させて形成される。

【００２１】そして、SiO_2薄膜５形成後、上記母基板をダイサー等により切断して、図１に示す個々の表面波素子１０が形成される。つまり、一方の方向においては、厚みの均一なSiO_2薄膜５が多数の表面波素子１０に亘って形成され、個々の表面波素子１０の境界線で基板１に対して垂直に切断されているので、基板１の対向する端面間に亘って、均一な膜厚のSiO_2薄膜５が形成される。

【００２２】次ぎに、図１に示す構成の表面波素子における膜厚分布及びフィルタ特性を従来のものと対比して説明する。

【００２３】ＲＦマグネトロンスパッタ法によりSiO_2薄膜を約８．６μｍ形成したときの、表面波伝搬方向と垂直な方向における膜厚分布を測定した結果を図３に示す。図３において、本実施例のSiO_2薄膜の膜厚分布を実線で、従来のものを破線で示す。破線で示すSiO_2薄膜がほぼ０μｍになる部分は、従来の図８に示すマスクでの窓の仕切部に対応する位置であり、この部分の間隔が表面波素子の表面波伝搬方向と垂直な方向の幅に相当し、実施例では３５００μｍの寸法である。なお、１段目～３段目の各共振子フィルタに相当する部分の幅をＡ，Ｂ，Ｃで示す。

【００２４】図３に示すように、従来のマスクにより形成したSiO_2薄膜の膜厚は不均一な分布となり、膜厚分布の平坦な部分は中央部の約１５００μｍの幅であ

り、１段目及び３段目の共振子部Ａ，Ｃに比べ、２段目の共振子部Ｂでの膜厚は平均で約０．３μｍ厚く形成され、１段目及び３段目の共振子部Ａ，Ｃ内では著しく不均一な膜厚分布となっている。これに対し、本実施例に係るSiO_2薄膜は幅の全長に亘って均一な膜厚分布となっている。

【００２５】また、従来の表面波素子ではマスクの位置合わせのずれがあると、各段間及び各段内での膜厚がさらに大きく変化するが、本実施例の表面波素子ではマスクの位置ずれがあっても、均一な膜厚分布を得ることができる。

【００２６】図４は、ＩＤＴ電極の総電極指対数を１段目及び３段目の共振子で１６対、２段目の共振子で１８対、各段の反射器電極の電極指を各５０本で形成した場合のフィルタ特性を示す図である。図４において、本実施例のものを実線で、従来のものを破線で示す。

【００２７】図４に示すように、破線で示す従来の表面波素子では、通過帯域内の低域側にリップルが生じ通過帯域幅が狭くなり、通過帯域外にも不要なリップルが生じ、また、群遅延特性にも大きなリップルが発生している。これは、１段目及び３段目の共振子と２段目の共振子でSiO_2薄膜の膜厚が異なるために音速差が生じ、共振子の中心周波数が異なるとともに、各段の共振子内においても音速に分布ができるためである。

【００２８】これに対し、実線で示す本実施例の表面波素子では、各段の配置方向の全長に亘ってSiO_2薄膜は均一な膜厚で形成されているので、通過帯域内にリップル等のない良好なフィルタ特性が得られた。

【００２９】また、従来の表面波素子において、上記のような不具合を低減するためには、膜厚の均一な部分を広げる必要があり、素子のサイズを大きくしなければならないが、本実施例の構成によれば、薄膜は端面間に亘って均一な膜厚で形成され膜の端部は直角に形成されているので、素子のサイズを大きくする必要はなく、より小形化することが可能となる。

【００３０】図５は、本発明の第２実施例に係る表面波素子の構成を示す図であり、（ａ）は平面図、（ｂ）は表面波伝搬方向の略断面図、（ｃ）は表面波伝搬方向と垂直な方向の略断面図である。図６は本実施例において用いたマスクの平面図である。

【００３１】図５に示すように、本実施例の表面波素子１０は、３６°ＹカットＸ伝搬の$LiTaO_3$基板１上に、２個のＩＤＴ電極２、２及びＩＤＴ電極２、２の両側に反射器電極３、３が形成された１段構成の縦結合型共振子フィルタである。基板１の対向する端面側であって、ＩＤＴ電極２、反射器電極３の形成位置よりも外側には、それぞれのＩＤＴ電極２から引出された複数の外部取出し電極４が形成されている。

【００３２】外部取出し電極４が形成された両端面側を除く、ＩＤＴ電極２及び反射器電極３が形成された中央部には両端面間に亘って、ＩＤＴ電極２及び反射器電極３を覆うようにSiO_2薄膜５が形成されている。

【００３３】この表面波素子１０は、図５に示す表面波素子１０が多数形成された母基板（図示せず）上に、図６に示すような一方の方向においてのみ多数の表面波素子に跨がって連続する細長い窓２１が多数並列するように形成された金属製のマスク２０を配置し、マスク２０の窓２１を通して、SiO_2をスパッタリングすることにより、窓２１に対応する部分にSiO_2を付着させてSiO_2薄膜５を形成し、その後、母基板をダイサー等により切断して形成されたものである。

【００３４】つまり、本実施例のSiO_2薄膜５は、表面波伝搬方向においては、図５（ｂ）に示すように、両端面間に亘って均一な厚みで形成され、表面波伝搬方向と垂直な方向においては、図５（ｃ）に示すように、基板１内に膜厚の不均一な縁端部があり、不均一な厚みで形成されている。

【００３５】この構成によれば、表面波伝搬方向におけるSiO_2薄膜は端面間に亘って均一な膜厚で形成されており、膜厚の変化がないので、反射波の位相が乱れることがない。つまり、薄膜の膜厚変化に起因する反射波の位相乱れによる電気的特性の劣化が起こらず、良好な電気的特性を得ることができる。

【００３６】さらに、薄膜は基板の端面間に亘って均一な膜厚で形成され、膜の端部が直角に形成されているので、反射器を基板の端面近くに配置することができ、素子のサイズを小形化することができる。

【００３７】なお、上記各実施例では圧電基板上に形成された反射器電極及びＩＤＴ電極を覆うようにSiO_2薄膜を形成した縦結合型共振子フィルタで説明したが、基板の種類、薄膜の種類、表面波素子を構成する電極の構成等は、これに限るものではなく、基板及び薄膜は圧電性または他の絶縁性薄膜でもよく、表面波素子を構成する電極としては、１つのＩＤＴ電極で構成されたものでもよい。

【００３８】例えば、ガラス等の絶縁基板上にＩＤＴ電極等を形成し、この電極上に、ＺｎＯ等の圧電性薄膜を選択的に形成する場合、あるいは、サファイア基板の全面にＺｎＯ薄膜を形成した基板上にＩＤＴ電極等を形成し、この電極上に、特性改善または電極保護のために絶縁性または圧電性の薄膜を選択的に形成する場合にも本発明を適用できる。

【００３９】

【発明の効果】以上説明したように、本発明によれば、基板上で特性上重要な方向において、薄膜は対向する端面間に亘って均一な膜厚で形成されているので、この方向における膜厚の変化に起因する特性劣化がなく、良好な特性を得ることができる。

【００４０】また、表面波素子の寸法を小さく形成することができるので、表面波素子を小形化するとともに、

１枚の母基板での取れ個数を多くすることができ、コストを低減することができる。

【図面の簡単な説明】

【図１】（ａ）は本発明の第１実施例に係る表面波素子の平面図、（ｂ）は表面波伝搬方向の略断面図、（ｃ）は表面波伝搬方向と垂直な方向の略断面図である。

【図２】本発明の第１実施例に係るマスクの平面図である。

【図３】本発明及び従来の表面波素子のＳｉＯ₂ 薄膜の膜厚分布を示す図である。

【図４】本発明及び従来の表面波素子のフィルタ特性である。

【図５】（ａ）は本発明の第２実施例に係る表面波素子の平面図、（ｂ）は表面波伝搬方向の略断面図、（ｃ）は表面波伝搬方向と垂直な方向の略断面図である。

【図６】本発明の第２実施例に係るマスクの平面図である。

【図７】従来の表面波素子が多数形成された母基板の平面図である。

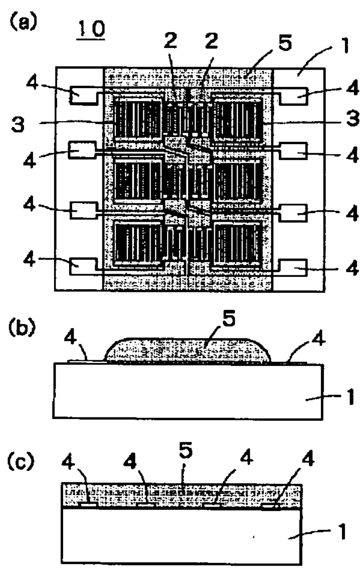
【図８】従来のマスクの平面図である。

【図９】（ａ）は従来の表面波素子の平面図、（ｂ）は表面波伝搬方向の略断面図、（ｃ）は表面波伝搬方向と垂直な方向の略断面図である。

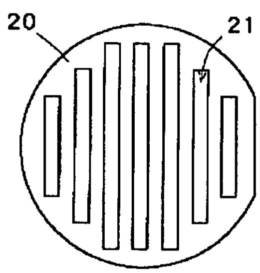
【符号の説明】

1	基板
2	ＩＤＴ電極
3	反射器電極
4	外部取出し電極
5	ＳｉＯ₂ 薄膜
１０	表面波素子
１１	母基板
２０	マスク
２１	窓

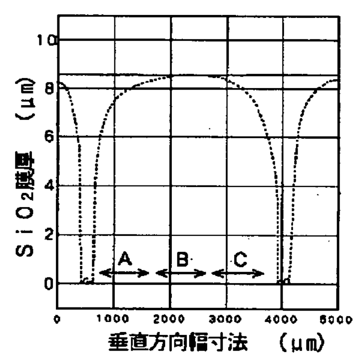
【図１】



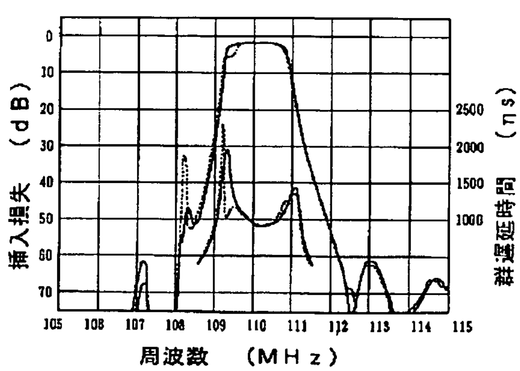
【図２】



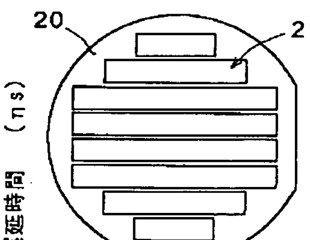
【図３】



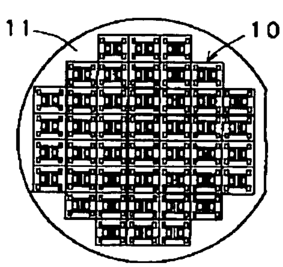
【図４】



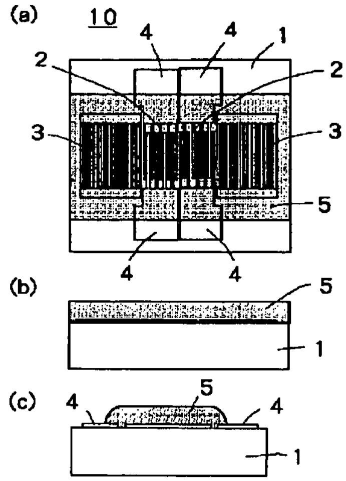
【図６】



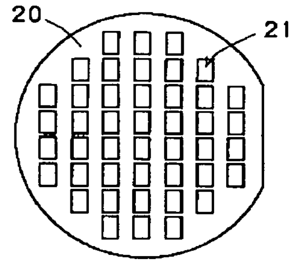
【図７】



【図5】



【図8】



【図9】